Reconstruction of medial patellofemoral ligament in treatment of recurrent patellar dislocation

* Mohamed El-sawy Habeeb, MD; **Amr Saber Omer, MD and ***Mohamed Bayoumi Awad

Department of orthopedic Surgery El-Menoufia university
*professor of Department of orthopedic Surgery Elmenofia university
**assistant professor
*** Mohammed Bayoumi Awad Awad
Correspondence to: Mohammed Bayoumi resident orthopeadic of surgery. Address: Damanhour Medical National Institute-Egypt
Tel:+201062911383
Email: dr_bayoumi_m@yahoo.com

The Egyptian Orthopedic Journal; 2021 supplement (1), June, 56: 91-97

Abstract

Background
Patellofemoral joint stability results from passive soft tissue tensions in the medial and lateral retinacular structures, active muscle tensions, trochlear architecture, and the reactive forces acting on the articular surfaces. The Medial Patellofemoral ligament (MPFL) is found to be a critical medial soft-tissue restraint in preventing lateral instability. Furthermore, biomechanical and radiographic findings have led many surgeons to state that disruption of the medial patellofemoral ligament is the "essential lesion" required for patellar dislocation. A lot of studies have shown that as long as you try to resemble the anatomy, the better results and the lower rates of failure and recurrence of dislocation.

Patients and methods
In the current study, twenty patients with recurrent patellar dislocation were surgically treated with MPFL reconstruction using patellar bone tunnels technique and autogenous tendon graft, and followed up to investigate the functional outcome of this technique.

Results
The age incidence ranged from 15 years to 35 years, the mean age was 25.9±6.3 years. Five males were affected while 15 females were affected. Among all the 20 cases in our study with mean follow-up period of 14.9□6.3 months , no cases of re-dislocation were seen**.** In addition, during the follow-up period, all patients showed a negative apprehension test (20/20, 100) while compression test was positive in 5 patients (5/20, 25%) and it was negative in 15 patients (15/20, 75%) and these figures of results denote good outcome after interference.

Conclusion
This study shows that anatomic MPFL reconstruction is a reliable treatment option with little associated morbidity for the treatment of patellar instability, especially in patients without bony abnormalities. The procedure described here offers the opportunity of an anatomical MPFL reconstruction. Reproducing the anatomy of the native MPFL enables the reconstructed ligament to have an isometric function and therefore being effective through a greater range of motion, enabling an early functional rehabilitation and avoiding an increase of patellofemoral pressure in higher degrees of knee flexion

Keyword
Patellar Instability, MPFL reconstruction.

Introduction

In the general population, the overall incidence of acute patellar dislocation is 5.8 per 100,000 people. The rate of patellar dislocation is estimated to be the highest in the age group of ten to seventeen years, with reported rates of 29% to 43%. Women have a 33% increased prevalence of acute patellar dislocation compared with men. Patellar instability typically occurs in patients with several anatomic risk factors, including both soft tissue and osseous abnormalities[1].

Due to the (Q) angle, with its resultant lateral vector, there is normally some tendency for the patella to displace laterally. This tendency is balanced passively by the medial ligaments (soft tissue) and by a buttress effect of the lateral femoral trochlea (osseous). The patella is balanced functionally by the orientation of the distal vastus medialis fibers. In the case of acute or recurrent dislocation, there is a breakdown of this equilibrium [2].

The **Medial Patellofemoral ligament (MPFL)** is found to be a critical medial soft-tissue restraint in preventing lateral instability. Furthermore, biomechanical and radiographic findings have led many surgeons to state that disruption of the medial patellofemoral ligament is the "essential lesion" required for patellar dislocation [3].

Several recent studies have documented the value of MPFL reconstruction for recurrent patellar dislocation and subluxation, and have investigated especially the association between clinical symptoms and patellofemoral congruency following different surgical techniques [4].

There are a lot of surgical techniques for reconstruction of MPFL which differ in the source of the graft used either Autograft or Allograft, the type of the graft used either semitendinosus tendon, quadriceps tendon or gracilis tendon and the configuration of graft fixation between the femur and the patella either single or double-limb technique. A lot of studies have shown that as long as you try to resemble the anatomy, the better results and the lower rates of failure and recurrence of dislocation [5].

In our study, a prospective case series was done to investigate the functional outcome of MPFL reconstruction using patellar bone tunnels technique using Autogenous tendon graft.

Patients and methods

Patients:

Twenty patients with recurrent patellar dislocation were included in this study. All patients were operated upon at El-Menoufia University Hospital and Damanhour Medical National Institute during the period from March 2016 to January 2018.

Inclusion criteria:

Minimum of 3 documented episodes of patellar dislocations, CT scan for assessment of TT-TG distance to be less than 20mm, and the age to be between 11 and 35 years old.

Exclusion criteria:

Q angle greater than 20 degree in female patients and greater than 17 degree in males, **Patella Alta** (Insall-Salvati index >1.2), **Trochlear Sulcus Angle** of 145 degree or greater on Merchant view, patients with **Dejour** grade **B, C, or D** had significant trochlear dysplasia and would require distal realignment surgery, and patients with **TT-TG distances** equal to or greater than 20 mm.

Methods:

1. Preoperative diagnosis and assessment:

- History.
- Clinical examination.
- Radiological evaluation.

2. Methods of treatment:

All patients were treated by MPFL reconstruction using patellar bone tunnels technique.

Anaesthesia:

Surgery was performed under spinal, epidural anaesthesia or femoral and sciatic nerve block.

Position:

The patient was placed supine, with a tourniquet applied to the thigh, following the administration of prophylactic antibiotics. The leg is then prepped and draped in the standard surgical fashion, elevated, and the tourniquet is inflated. To avoid capturing the quadriceps with the tourniquet, the leg is fully flexed before tourniquet inflation. Skin preparation and sterile draping was performed in the usual fashion (Fig. 1).

Figure 1 : Disinfecting and drapping the affected leg

Procedure:

An examination under anesthesia was performed to confirm the diagnosis of patellar instability and hypermobility (Fig. 2).

Figure 2: Examination showing marked patella dislocation under anesthesia

Initially, an arthroscopy is performed to inspect the cartilaginous situation, to evaluate any intraarticular lesions and patellar tracking throughout the knee motion or removal of loose bodies as needed.

Harvesting and preparing of the graft:

After completion of the arthroscopy, a 2 cm long incision is performed over pes anserinus about 5–10 mm distal to the tibial tuberosity on the anteromedial side. After incising the sartorius aponeurosis, the gracilis tendon was our first choice since it is known that the mean load to failure force of the MPFL is 208 N, which can be easily sustained by a single bundle gracilis graft (Fig. 3).

Figure 3: Harvesting of the graft using a tendon Stripper.

Preparing the patellar insertion site:

A 3-cm para-patellar incision was made along the medial border of the patella. The exposure was facilitated by placing the knee in full extension (Fig. 4). A 2.4-mm guide pin was placed into the superior third of the patella at the insertion point of the intact MPFL through medial para-patellar incision. One transverse tunnel was drilled over the guide pin, exiting the symmetric lateral surface position of the patella. In this way, the second tunnel was drilled at the midpoint of the medial border of patella, parallel to the first one, separated approximately by a 1-cm bone bridge traversing the whole width of the patella. Each tunnel must also be directed to avoid lesions of patellar articular cartilage intra-articularly (Fig. 5). After each pin was drilled, a finger can be used to palpate articular cartilage surface (Fig. 6).

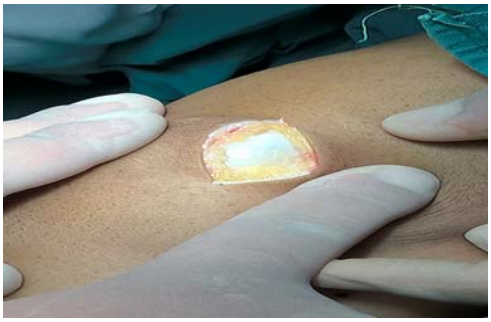

Figure 4: Medial paras-patellar incision.

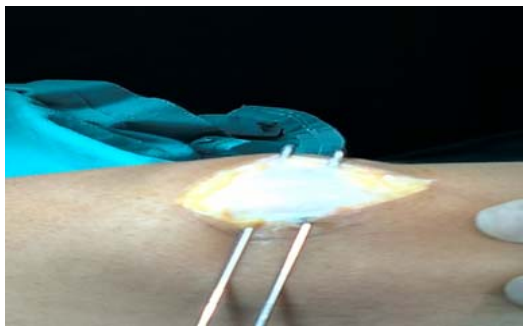

Figure 5: The 2 guide pins insertion.

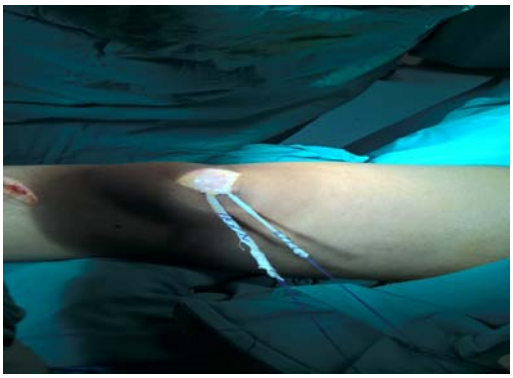

Figure 6: The passage of the graft through the patellar tunnels.

Preparing the femoral insertion site:

The second and the third layer of the medial patellofemoral complex, where the MPFL is anatomically situated , were separated from each other down to the femoral insertion side (**The Schottle Point**) [85], with care to avoid injury of the capsule. In 30° knee flexion, a 1 cm longitudinal skin incision is performed in the area of the medial epicondyle and the adductor tubercle. A first suture loop for pulling the graft from the patellar to the femoral site is inserted in between the second and the third layer with the loops towards anterior. For an anatomical femoral insertion of the graft (Schottle Point), the medial epicondyle and the adductor tubercle are palpated and a guide wire with an eyelet is placed at a point 8.8 mm anterior to a line continuous with the posterior cortex of the femur and 2.6 mm proximal to a perpendicular line at the level of the posterior aspect of **Blumensaat's** line on a lateral view with the posterior condylar margin overlapped. Guide wire placement and drilling direction are controlled by a picture intensifier on a straight lateral view aiming slightly superior and anterior to avoid vital structures (Fig. 7). The drill hole is created up to the contralateral cortex with a 6 mm reamer. A second suture loop for pulling the graft into the tunnel is inserted with the help of the guide wire, placing the loop at the medial side.

Figure 7: Fluroscopic guided anatomical femoral insertion of MPFL.

Graft fixation:

The graft was first pulled into the femoral tunnel maximally in full extension. The knee was then brought to full flexion several times to accommodate the graft, a movement that consistently retracted the graft slightly out of the femoral tunnel. The graft was fixed with a biodegradable interference screw (7*25 mm) in 30° of kanee flexion, since biomechanical studies have shown that the MPFL has its maximal restraint against patella lateralization in 30° of knee flexion. The screw is turned into the tunnel, when the lateral patellar edge is in line with the lateral femoral condyle edge, thus reconstructing the anatomy of the original MPFL. Full range of motion is controlled before screw driver removal and patellar tracking is checked between 0° and 40° of knee flexion, when the medial patellofemoral complex has the main restraint against patellar lateralization. Next, the medial retinaculum and remnant MPFL were sutured to cover the embedded graft. Both incisions were irrigated and closed in layers. Tourniquet was deflated prior to closure to achieve adequate hemostasis. Sterile dressings were applied, and the knee was placed in a hinged calibrated brace.

3. Rehabilitation and Follow up:

1. 3 weeks Postoperative the patient will be allowed for:

A. Partial weight bearing in immobilizer using 2 crutches.

B. Exercises: Range of motion exercise: began immediately, but the knee flexion angle was restricted to 30˚ , 60˚ , and 90˚ in the first, second, and third 2-week periods after the operation, respectively. Static exercise for quadriceps.

2. The patient will start physiotherapy after 3 weeks and allowed for full weight bearing in immobilizer.

3. After 6 weeks the patient will discard immobilizer and continue physiotherapy.

Statistical analysis:

Two types of statistical analysis were done:

- Descriptive statistics: e.g. percentage (%), mean and standard deviation (SD).

- Analytic statistics: Chi-square test ($\chi 2$); a test of significance used to study the association between two qualitative variables. Student t-test; a test of significance used for comparison between two groups having quantitative variables.

P-value of <0.05 considered statistically significant.

Results

The age of the patients of the study ranged between 15-35 years with a mean age of 25.9□ years. Five of our patients were males (5/20, 25%) while 15 were females (15/20, 75%) with a male to female ratio of 1:3, (Fig. 68). One of our patients had no job (1/20, 4%) while 19 had job (19/20, 96%) five of them were students (5/19, 26.3%), two were manual workers (2/19, 10.5%), 10 were housewives (10/19, 52.6%) while one was driver and another was carpenter (1/19, 5.3%) (Fig.69). The etiology of the pathology in our patients was atraumatic conditions in 6 cases (6/20, 30%) while traumatic cases constitute 70% of our patients (14/20) and the statistical analysis revealed the predominance of traumatic causes (p = 0.021) (Fig. 70). Right side was affected in nine cases (9/20, 45%) in our patients while in 11 patients (11/20, 55%) of patients the left side was affected and the statistical analysis didn't reveal the significant of one side on the other to be affected (p = 0.311) (Fig. 71). Gracilis flap was used in nine cases (9/20, 45%) of our patients while in 11 patients (11/20, 55%) of patients semitendinosis graft was used (Fig. 72). The full weight bearing period ranged between 4-6 weeks with a mean of 4.7□0.9 weeks. Also, the period were the patient had full range of motion ranged between 8-10 weeks with a mean period of 8.3□0.6 week (Fig. 6). After interference patients of the study were followed up for a period ranged between 5-27 months with a mean period of 14.9□6.3 months (Fig. 73). IKDC score of patients before interference was ranged between 20.7-72.4 with a mean score of 43.1□12.9 while post interference it ranged between 35.6-92 with a mean score of 66.3□17.2 and the statistical

analysis revealed significant improvement in the IKDC score of patients post-interference (p = 0.021).

Kujala score of patients before interference ranged between 18-79 with a mean score of 52.3□15.5 while post interference it ranged between 46-94 with a mean score of 73.1□14.6 and the statistical analysis revealed significant improvement in the Kujala score in patients post-interference (p = 0.023).

Cincinnati score of patients before interference ranged between 10-86 with a mean score of 48.3□20.1 while post interference it ranged between 44-100 with a mean score of 72.8□16.9 and the statistical analysis revealed significant improvement in the Cincinnati score in patients post-interference (p = 0.001).

Lysholm score of patients before interference ranged between 2-90 with a mean score of 54.9□19.8 while post interference it ranged between 44-100 with a mean score of 78.9□16.5 and the statistical analysis revealed significant improvement in Lysholm score in patients post-interference (p = 0.001).

During the follow-up period all patient showed a negative apprehension test (20/20, 100) while compression test was positive in 5 patients (5/20, 25%) and it was negative in 15 patients (15/20, 75%) and these figures of results denote good outcome after interference.

Seventeen of our patients passed completely free post-operatively without complications (17/20, 85%) and complications were present only in three cases (3/20, 15%) one of them (1/3, 33.3%) was due to infection of the wound (superficial infection) which was treated with appropriate antibiotic after culture and sensitivity which control the infection process and the other two cases (2/3, 66.7%) were complicated by patello-femoral pain and were treated by non-steroidal anti-inflammatory drugs (NSAIDs) showed improvement after this therapy.

Discussion

The optimal surgical treatment for chronic patellar instability is controversial. There are numerous techniques which had been used with varying success. Medial capsule plication and lateral capsule release, called proximal realignment, have been investigated in a few studies. **Scuderi** et al reported a low redislocation rate of 3% with isolated proximal realignment [6]. A similar finding was reported by **Aglietti** et al and **Zeichen** et al [7]. While on the other hand medial transfer of the tibial tuberosity, called distal realignment, has been used in isolation, with unsatisfactory results in approximately 20% to 25% of patients [8, 9]. However, in a study by **Shelbourne** et al, a re-dislocation rate of 0% was found in 34 patients with patellar instability but 25% had persistent symptomatic instability [10]. Finally, a combination of all the previously mentioned procedures, called the **Roux** procedure, has resulted in better redislocation rates of 5% to 10% [11, 12].

As a result of the high failure and redislocation rate with previously mentioned procedures, medial patellofemoral ligament reconstruction is becoming the most widely adopted procedure for recurrent patellar dislocation. The first English-language report of an MPFL reconstruction method was in **1992**, with an artificial polyester ligament fixed in a transverse drill hole of the patella, and then fixed to the medial femoral condyle with a metal screw [13]. Before this, in **1990**, **Suganuma** et al described an MPFL reconstruction method involving an autograft tendon or an artificial ligament in the Japanese literature [14]. From the **1990s** onward, numerous different techniques for MPFL reconstruction have been described, including use of a free semitendinosus, gracilis, quadriceps, or adductor tendon, or a vastus medialis retinaculum autograft [15, 16].

Among all the 20 cases in our study with mean follow-up period of 14.9±6.3 months, no cases of redislocation were seen. **Nomura** had two cases of redislocation/subluxation among 24 knees with mean follow-up period of 11.9 years. **Christiansen** et al followed 44 patients for 12–32 months and they had one case of patellar re-dislocation and 3 cases with subluxations. **Ronga** had seen 3 cases of redislocation after MPFL reconstruction for 28 knees followed for 3.1 years. **Song SY** had done MPFL reconstruction for 20 knees with mean follow up period of 34.5 months with no cases of redislocation [17, 18, 19].

Kujala score has improved in our cases from 52.3 to 73.1. In **Nomura** study **Kujala** score was 94.2 (from 63.2). In **Christiansen** cases **Kujala** scores improved overall from 46 to 84 points compared to improvement from 45 to 83 with **Ronga**. **Song SY** had **Kujala** scores increased from 52.6 to 90.9 [17, 18, 19].

Our **Cincinatti** score improved from 48.3 to 72.8, while with **Ronga**, **Cincinatti** improved from 52 to 89. Our **Tegner-Lysholm** score improved from 54.9to 78.9 compared to **Song SY** who had improvement from 49.2 to 90.9 [18].

IKDC improved in our study from 43.1 to 66.3, and the statistical analysis revealed significant improvement in the IKDC score of patients post interference.

The limitation of this study is that it was conducted on

a small number of cases (20 cases) without a control group. Another weakness point is short term follow-up duration; 14.9±6.3 months (Min 5 : Max 27 months). The long term, comparative studies with large number of patients were required to corroborate our findings.

The clinical relevance of the present study is that MPFL reconstruction is a good treatment option with little associated morbidity for the treatment for patellar instability, especially in patients without bony abnormalities.

Conclusion

The medial patellofemoral ligament (MPFL) is the primary soft-tissue restraint for lateralization of the patella. The biomechanical properties of the MPFL during knee motion are crucial for the maintenance of patellar stability and for the control of normal kinematics of the patellofemoral joint, particularly at low flexion angles. It has been reported that the MPFL is ruptured in the majority of acute patellar dislocation, and insufficiency or slackening of the MPFL is the essential lesion of recurrent patellar dislocation. Accordingly, it appears that surgical treatment is required to restore patellar stability. Over the past decade, MPFL reconstruction has become more popular for the treatment for recurrent lateral patellar instability.

In conclusion, this study shows that anatomic MPFL reconstruction is a reliable treatment option with little associated morbidity for the treatment for patellar instability, especially in patients without bony abnormalities. The procedure described here offers the opportunity of an anatomical MPFL reconstruction. Reproducing the anatomy of the native MPFL enables the reconstructed ligament to have an isometric function and therefore being effective through a greater range of motion, enabling an early functional rehabilitation and avoiding an increase of patellofemoral pressure in higher degrees of knee flexion.

References

1. Panni AS, Alam M, Cerciello S, Vasso M, Maffulli N. Medial patellofemoral ligament reconstruction with a divergent patellar transverse 2-tunnel technique. The American journal of sports medicine. 2011;39(12):2647-55.
2. Asaeda M, Deie M, Fujita N, Shimada N, Orita N, Iwaki D, et al. Knee biomechanics during walking in recurrent lateral patellar dislocation are normalized by 1 year after medial patellofemoral ligament reconstruction. Knee surgery, sports traumatology, arthroscopy: official journal of the ESSKA. 2016.
3. Han H, Xia Y, Yun X, Wu M. Anatomical transverse patella double tunnel reconstruction of medial patellofemoral ligament with a hamstring tendon autograft for recurrent patellar dislocation. Archives of orthopaedic and trauma surgery. 2011;131(3):343-51.
4. Deie M, Ochi M. Medial Patellofemoral Ligament Reconstruction: Current Concepts. Sports Injuries: Prevention, Diagnosis, Treatment and Rehabilitation. 2015:1237-43.
5. Weinberger JM, Fabricant PD, Taylor SA, Mei JY, Jones KJ. Influence of graft source and configuration on revision rate and patient-reported outcomes after MPFL reconstruction: a systematic review and meta-analysis. Knee Surgery, Sports Traumatology, Arthroscopy. 2016:1-9.
6. Scuderi G, Cuomo F, Scott WN. Lateral release and proximal realignment for patellar subluxation and dislocation; A long-term follow-up. J Bone Joint Surg Am 1988;70: 856-861.
7. Aglietti P, Buzzi R, De Biase P, Giron F. Surgical treatment of recurrent dislocation of the patella. Clin Orthop Relat Res 1994;8-17.
8. Brown DE, Alexander AH, Lichtman DM. The Elmslie-Trillat procedure: Evaluation in patellar dislocation and subluxation. Am J Sports Med 1984;12:104-109.
9. Conti C, Berruto M, Bianchi M. The Elmslie-Trillat procedure for recurrent subluxation of the patella. One to five year follow-up. Ital J Orthop Traumatol 1992;18:341-349.
10. Shelbourne KD, Porter DA, Rozzi W. Use of a modified Elmslie-Trillat procedure to improve abnormal patellar congruence angle. Am J Sports Med 1994;22:318-323.
11. Peterson L, Karlsson J, Brittberg M. Patellar instability with recurrent dislocation due to patellofemoral dysplasia. Results after surgical treatment. Bull Hosp Jt Dis Orthop Inst 1988;48:130-139.
12. Cox JS. Evaluation of the Roux-Elmslie-Trillat procedure for knee extensor realignment. Am J Sports Med 1982;10:303- 310.Arch Orthop Trauma Surg 2010; 130(4):459-64.
13. Ellera Gomes JL. Medial patellofemoral ligament reconstruction for recurrent dislocation of the patella: a preliminary report. Arthroscopy 1992;8:335-340.
14. Suganuma J, Mitani T, Suzuki N, et al. Reconstruction of the medial patellofemoral ligament [in Japanese]. J Tokyo Knee Soc 1990;10: 137-148.
15. Cossey AJ, Paterson R. A new technique for reconstructing the medial patellofemoral ligament. Knee 2005;12:93-98.
16. Muneta T, Sekiya I, Tsuchiya M, Shinomiya K. A technique for reconstruction of the medial patellofemoral ligament. Clin Orthop Relat Res 1999;359:151-155.
17. Christiansen SE, Jacobsen BW, Lund B, Lind M. Reconstruction of the medial patellofemoral ligament with gracilis tendon autograft in transverse patellar drill

holes. Arthroscopy 2008;24:82–87.

18. Ronga M, Oliva F, Longo UG, Testa V, Capasso G, Maffulli N. Isolated medial patellofemoral ligament reconstruction for recurrent patellar dislocation. Am J Sports Med 2009;37:1735–1742.
19. Song SY, Kim IS, Chang HG, Shin JH, Kim HJ, Seo YJ, Anatomic medial patellofemoral ligament reconstruction using patellar suture anchor fixation for recurrent patellar instability, Knee Surg Sports Traumatol Arthrosc 2013;54:2730-6.